DOCUMENT RESUME

ED 235 599 EC 152 556

AUTHOR White, Marilyn R.; And Others
TITLE Computer Networking with Commercially Prepared Software.
PUB DATE 7 Apr 83
NOTE 38p.; Paper presented at the Annual International Convention of The Council for Exceptional Children (61st, Detroit, MI, April 4-8, 1983).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Programs; *Disabilities; Elementary Education; *Mathematics Instruction; Microcomputers; *Networks; Program Development; Student Attitudes

ABSTRACT

A federally funded project investigated a computer networking system in special education being implemented in Johnson County, Wyoming. The goals of the networking system project were: (1) to demonstrate a computer networking system as it applies to an educational setting; and (2) to conduct a research project to study the effects of computer assisted instruction (CAI) on mathematics achievement and attitudes toward mathematics and computer use. As a first step, teachers were familiarized with microcomputers through a variety of inservice approaches, including self instruction. A program was then developed to assist staff in locating CAI programs which taught specific math objectives. Students then participated in CAI coordinated with objectives from the Key Math Test. A networking system was designed to deliver CAI services through a disk sharing system and a central memory device. Use of the CAI approach in math was evaluated with 16 handicapped and 16 educationally disadvantaged elementary students. Preliminary results yielded no significant differences between performance of CAI and control groups on the Key Math Diagnostic Arithmetic Test and the Stanford Diagnostic Mathematics Test. Attitudes toward math and CAI were measured for 19 handicapped and 26 disadvantaged students (representing two elementary schools). Results of the Buffalo Questionnaires (a locally developed instrument) and the Mathematics Attitude Scale indicate that handicapped and disadvantaged students have similar attitudes toward mathematics and CAI may be effectively used with these populations without dehumanizing effects. (CL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED235599

COMPUTER NETWORKING WITH COMMERCIALLY PREPARED SOFTWARE

PRESENTATION: COUNCIL FOR EXCEPTIONAL CHILDREN NATIONAL CONFERENCE
DETROIT, MICHIGAN APRIL 7, 1983

PRESENTERS: MARILYN R. WHITE, PH.D.
PROJECT DIRECTOR
COORDINATOR OF SPECIAL SERVICES
JOHNSON COUNTY, WYOMING, SCHOOL DISTRICT NO. 1
BUFFALO, WY. 82834

DAVID R. RIEGER, M.S., M.ED.
TECHNOLOGICAL CONSULTANT
RESOURCE SPECIALIST
JOHNSON COUNTY, WYOMING, SCHOOL DISTRICT NO. 1
BUFFALO, WY. 82834

ROBERT L. WILKES, M.S.
RESEARCH CONSULTANT
INSTRUCTOR OF PSYCHOLOGY
CASPER COLLEGE
CASPER, WY. 82601

EC152556

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Marilyn R White
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CONTENTS

	Page
Acknowledgements	ii
Abstract	1
Introduction	2
Inception of the Project	3
Planning and Development	8
Computer Networking Design	11
Research Design and Preliminary Results	15
Future of Project	26
Summary	28
Appendix A - Figure 1	29
Appendix B - Figure 2	30
References	31

ACKNOWLEDGEMENTS

Appreciation is expressed to the Board of Trustees and the administration of Johnson County, Wyoming, School District No. 1 for their approval and support of this project.

A very special thank you must be extended to my colleagues, Mr. David Rieger and Mr. Rob Wilkes, and to the staff and administrators of the schools involved. These are the people who made implementation possible.

Marilyn R. White, Ph.D.

COMPUTER NETWORKING WITH COMMERCIALLY PREPARED SOFTWARE

ABSTRACT

This presentation/demonstration will follow the development and implementation of a Title IV-C project currently in operation in Johnson County, Wyoming, School District No. 1. The project has as its goals 1) to demonstrate a computer networking system as it applies to an educational setting; 2) to conduct a research project to study the effects of computer assisted instruction on mathematics achievement and attitudes toward mathematics and computer use.

Discussion will center around the following: the inception of the project; planning and development; the computer networking design; the research design and preliminary results; the future of the project, conclusions and recommendations.

INTRODUCTION

The impetus for this presentation grew out of a Title IV-C project entitled "Computer Assisted Instruction For Handicapped Students." This federally funded project is presently being implemented jointly by the Special Services Department and two elementary schools located within Johnson County School District No. 1.

Title IV-C, now defunct and incorporated into the block grant program, had as its purpose to "strengthen the quality of elementary and secondary education through support of locally initiated projects and activities designed to improve educational practices." The intent of the Johnson County project was twofold: 1) to design a research study to investigate primarily the effects of computer assisted instruction with handicapped students; 2) to demonstrate a computer networking system within an educational setting.

INCEPTION OF THE PROJECT

In the fall of 1981, district administrators determined to "investigate utilization of computers" as one of the district goals. This decision sprang from grass roots interest and budding expertise among staff. As a follow up to this directive, the department of special services began to investigate hardware, networking systems and available instructional software as preliminary steps to a project proposal. The population served by special services seemed to be an ideal population for an initial study. It could provide an N of manageable size, students had detailed educational plans, and teachers of these students are facile in dealing with the intricacies of precision teaching.

To provide additional support for a project proposal, a needs assessment was conducted. Groups surveyed included parents, regular instructional staff, special education/related services staff and students. In summary, results were as follows:

> Parents seemed to be concerned that microcomputers not become a dehumanizing factor in the education process. Their awareness level of microcomputers was very low as was seen in their answers and from other comments. Their feeling about microcomputers was one of lack of knowledge; they felt good to fair about having their children using them. The subject area that seemed to be of most interest to them was math/ arithmetic.
>
> To a large degree, regular instructional staff had minimal knowledge about microcomputers, but they were intrigued about having one in their classrooms. When asked for an area in which microcomputers could be of assistance in the education of their students, the six areas listed were given almost equal weight. When asked to rank the same areas from most to least important, mathematics by far, was ranked first the most often.

> The special education/related services staff had an awarness level similar to the regular instructional staff - none to minimal. When asked to choose areas within the special education workscope where they would like to use computers, their choices received almost equal weight. When these same areas were ranked by the staff according to importance, direct student instruction received the greatest number of first choices, The special education staff was also intrigued about having a computer in their classrooms. The comments about other areas in which microcomputers could play a significant role tended to deal with management type activities. Finally, the special education/related services staff listed most instructional areas for possible use on a CAI System.
>
> The students surveyed were concerned with the dehumanizing effect of computers. They had good feelings about the future of computer use and the ways in which computers can be used in and out of the educational setting. These students appeared to be ready for computer assisted instruction on a full time basis in the classroom.

One last step, a review of the literature, had to be completed before the decision could be made to prepare and submit the Title IV-C project application. In September, 1980, the Wyoming task force on instructional computing prepared a report which summarized data related to educational computer use. Among the conclusions reached by this group, the following had relevance for this study (Univ. Wyo., 1981).

> Both elementary and secondary educators support the use of computers by all teachers to learn programming and to provide instructional services.
>
> Both elementary and secondary educators support the use of computers as a special learning resource for the gifted and to provide every student with experiences (not necessarily programming) in applying computers in his/her area of subject matter interest.
>
> The four most popular instructional uses of computers in the secondary school are, in order of popularity, teaching programming, instructional gaming, problem solving, and drill/practice. The chief use reported for elementary schools is instructional gaming; it is followed by a three-way tie among teaching programming, problem solving, and drill/practice. The rates for problem solving at both levels are questioned; there is a strong possibility that respondents did not distinguish problem solving from drill/practice.

> Elementary and secondary educators who have access to a computer support the use of the computer to teach every student about computers and their role in society, as a special learning resource for handicapped students, and to provide technical/vocational skills for students who are not college bound.
>
> In general, educators do wish to learn about computers and wish to use them with their students. Secondary educators and educators who have access to computers are more supportive of the positions (changes) suggested by the survey. Far from being possessive, computer-using educators appear eager to encourage other educators to use computers and to explore new ways to use computers to serve students and teachers.

It should be noted that this committee reported agreement of at least 66 percent of the respondents with these positions. In further support of this state-wide survey, Johnson County School District No. 1 educators expressed similar opinions.

Attitudes and opinions seemed to favor computer application in education. However, as observed by Joiner, relatively few research studies had been done particularly in regard to instruction of handicapped students (Joiner, et al, 1980). Of those studies reported in the literature, the following should be noted. Two studies by Edwards et al (1975), and Suppes and Morningstar (1977), concluded that computer assisted instruction (CAI) seemed to be more effective with low ability students than with middle or upper ability students. Both studies dealt with cognitive and affective variables. In a study by Tolor (1969), dealing with student motivation and affective objectives, a positive effect was found as a result of CAI. These findings were further supported by Crandall and Mantano (1977). It appeared that favorable results had thus far been found but the need for additional research was evident.

An interesting study was reported by Lewis and Rossett (1980) which investigated the overlap of educational technology and special education. Respondents, special education administrators and special education students, were asked to define educational technology and to rate the usefulness of certain technological competencies to special educators. For the most part, special educators did not even venture a definition while students seemed to be more willing to attempt some sort of an explanation. Special educators saw no significant overlap between technology and special education. Perhaps a need for continued teacher preparation and support can be demonstrated by the Johnson County study.

A major consideration in a decision to incorporate CAI for children with special needs is the potential for normalization. The computer provides for independent programming within the same classroom, thereby reducing the need to isolate children requiring special instruction. Because computers are infinitely patient and structured, they provide good motivation and reinforcement for the student who needs immediate feedback and an opportunity to correct responses. Many handicapped students have attentional problems and achievement suffers because of their inability to remain on task. The computer allows for attention to be drawn to the "figure" while the "ground" can be minimized. Some learning disabled students have a long latency of response period and, therefore, need more time to process their answers. Computers can be programmed to accommodate this deficit and can be used to assist the student in moving toward a quicker response (Grimes, 1981).

The graphics capabilities of microcomputers offer an endless array of ways to present concrete information to children with low cognitive abilities. With the addition of a phone modem, homebound as well as the visually impaired students have a vast amount of instruction made possible. With the development

of the Optacon (Optical-Tactile Converter), the visually impaired have printed letters translated into vibrating letters readable by touch (Ashcroft, Young, 1981).

The literature suggested that educators are willing and anxious to find effective uses for computers in the instructional process. Technologists appear anxious to provide the assistance necessary to put computers in the classroom. Research was needed in order to provide the educational governing bodies the data necessary for decision making. Hence, the determination to procede with the development of the Johnson County Title IV-C application was made.

PLANNING AND DEVELOPMENT

Before the Title IV-C project was approved and actually begun, a number of activities (some planned and some unplanned) took place.

"Meet The Apple II"

This first activity, though not designed as a part of the Title IV-C project, proved to be useful in preparation of school district educators. "Meet The Apple II" was developed to acquaint non-computer users with some beginning information and hands-on experience about microcomputers. This self-instruction inservice activity was approved by the Wyoming State Department of Education for one unit of credit and consisted of three parts. The first was a slide-tape presentation entitled "Computer Applications in the Community" that explained how the computer was being used by businesses in Buffalo. The second was the computer program "Introduction To The Apple Keyboard", produced by Apple Computer, Inc. The third was the Science Research Associates computer program and workbook "Computer Discovery". As of this date, 27 certified staff members and 12 non-certified staff members have completed this inservice. Of special interest to the project was the fact that the project director, project technological consultant, and all of the teachers directly involved with the work of the project successfully completed this inservice activity. "Meet The Apple II" was the first contact some of these individuals had with microcomputers.

Inservice for Title IV-C Staff

In addition to the "Meet The Apple II" inservice, other inservice activities were developed to train the staff on how to use computer programs for the delivery of CAI. The use of the Corvus Omninet Networking System was also explained to the staff and the equipment was installed at the beginning of the 1982-83 school year.

Staff members were urged to make themselves familiar with the operation of the network and they were able to use the system from September through December of 1982, before the actual research portion of the project began. CAI programs were added to the Omninet memory system during this period and formal inservice workshops were held to deal with any difficulties that might have been encountered from the operation of the system or the use of the CAI programs.

Student Training

Students were also given training during this same time period. Instructions on how to access the networking system were developed and students were allowed to begin working with some of the CAI programs. By the time the research gathering part of the project began, all of our student subjects (except for the very youngest) were able to access the networking system and run a given program by themselves.

"Math Program Search"

This program was developed specifically to assist project staff in locating CAI programs which taught specific math objectives. "Math Program Search" uses the 209 math objectives from the Key Math Test (American Guidance Service) to locate the programs that teach these objectives. This program also generates a cross reference chart between the Key Math objectives. Houghton/Mifflin objectives (the District's basal math text), and the Boehm Test of Basic Concepts. The data can be either displayed on a monitor or printed as hard copy.

All of the CAI programs used in the project were coded by Key Math objectives and this data was entered into the text files of "Math Program Search." The program also allows the user to enter student data for each search so that this information could become part of an I.E.P. (individual

educational plan).

Since the educators who participated as Title IV-C staff were also full time classroom teachers, it was felt that any help they could receive in locating appropriate CAI programs would make their work load easier. The previewing of computer software can be very time-consuming and "Math Program Search" has helped to reduce some of this work.

Selection of Assessment Instruments

The data for the project was collected using three devices: The Key Math Diagnostic Arithmetic Test, the Stanford Diagnostic Mathematics Test, and surveys that utilized the Mathematics Attitude Scale and a locally developed questionnaire.

Key Math was used as a primary source of determining mathematics performance with the Stanford Diagnostic supplying additional data. The surveys were used as the source of information regarding attitude toward mathematics and the educational application of computers.

COMPUTER NETWORKING DESIGN

After investigation of various computerized delivery systems, the Project Staff decided to use a networking system as a means of CAI delivery. Although somewhat expensive initially, this method of sharing a memory device has proven to be very effective in the classroom.

Delivery of CAI

One important decision facing any potential user of microcomputers is the type of computer to be selected. For this project, the Apple II+ Microcomputer was chosen based upon several factors:

Software - The Apple has the most extensive amount of software available for a microcomputer now on the market. Since the Apple has about 40% of the kindergarten-grade 12 market and 50% of the higher education market, according to Geller (1983), we felt that this machine would be well supported now and in the future.

Networking - With the use of different inerface cards, the Apple can be used with a variety of systems, such as the Corvus Omninet, Apple Bus, and a whole variety of others to allow one desk drive (hard or floppy) to serve a number of users.

Design - The Apple comes in a sturdy cabinet with a "standard" typewriter keyboard. This unit is designed for hard and continuous use and with its ability for expansion, it can be modified for future applications with special input/output devices for the handicapped.

Support in the District - The Johnson County School District had already made somewhat of a committment towards the Apple by purchasing a number of these machines. It was felt that a continuation of this committment would serve to strengthen computer use within the District.

Support in Wyoming - In preparation for the Title IV-C Project Proposal, an informal statewide survey of school districts found the Apple Microcomputer to have the most support. More school districts in Wyoming have purchased Apples over any other type of microcomputer. The University of Wyoming, in offering classes in microcomputer use and programming, uses the Apple.

Floppy Disks Vs Network

In looking at the most practical method of using microcomputers for CAI, the floppy disk was found to be less than desirable for several reasons:

1. The teacher would have to share the CAI programs. Therefore, any program could be used by only one computer at any given time. Multiple copies would be financially restrictive.
2. More teacher control would have to be used to insure that the disks would not be damaged by the students. Floppy disks need extra careful handling.
3. The goal of having handicapped students control a greater portion of their own education could not be reached due to the need for increased teacher control of the software.

The use of a central memory device, such as a hard disk, was seen as a way to avoid some of these problems. Yet disk sharing also has a number of disadvantages that have been identified by Fisher (1982). Advantages include:

1. The use of disk sharing can save the educator time and energy. Since all data is located at one place, management becomes very simple.
2. The teacher has more control. With some systems, one can restrict access to parts of the memory. This allows the educator to manage program or file usage.
3. In the long run, a great deal of money can be saved. Instead of providing memory devices (or disk drives) at each microcomputer, a central device is

shared. Also, other peripherals can be shared.

Disadvantages include:

1. Disk sharing systems are not portable. The microcomputers have to be wired to the system.
2. Not all systems restrict access to the memory. Some students might be able to damage files or to completely destroy data.
3. Technical limitations might cause considerable problems. Some systems allow only one student access to a program at a time. Other systems have different limitations.

The Project Staff found several aspects of the Corvus Omninet disk sharing system to be very desirable. All programs are available at all times to every computer on the network. Teachers do not have to act as policemen to safeguard the floppy disks. Students can access programs by themselves. Lastly, the general availability of a vast library or software on the network allows the teacher and student much greater latitude in using the computer. With all of these factors considered, it was decided to purchase the Corvus Omninet System to interface with the Apple II+ Microcomputer.

Networking System Design

The design of the networking system is very simple. An inexpensive two-strand wire is ued to connect each computer to a central memory device, in this case a Corvus Winchester Hard Disk (Appendix A, Figure 1). Each computer is equipped with an interface card that allows it to "talk" via the wire to the disk server and Winchester hard disk. Although only one computer can use the wire at any given time, the system works so fast (approximately 4 to 6 times the speed of a floppy disk drive), that there is almost no delay if multiple use is requested.

The disk server is a device that "remembers" the location of each computer on the network and to what part of the hard disk it has access. All in all, this type of networking system has proven to be reliable, fast, and easy to use.

Agreements For Network Software

The Title IV-C Project uses commercially prepared software. It was found that most software producers are very new to the business and what was being asked of them in regard to using the programs on a hard disk system was completely new. The Corvus Omninet System needs uncopy-locked or protected software in order that these programs can be placed on the hard disk. This is due to the fact that a copy must be made of the program from a floppy disk to a volume on the hard disk.

Most software producers are very concerned that their software might be stolen by unscrupulous computer users so, to them, our need was almost heresy. Therefore, a special arrangement was made with each software producer to protect their software from unlawful copying. Additional fees were paid for these programs to offset the additional use they would get via a network.

Software

One of the primary goals of the project was to allow the special education classroom teacher to have the largest selection of CAI math programs possible. Although the selection of software for the network was somewhat limited, when the research gathering part of the project began, almost every Key Math objective was represented by at least one CAI program.

RESEARCH DESIGN AND PRELIMINARY RESULTS

Research Problem

The research problem under investigation in this project is the effect of computer assisted instruction on mathematics achievement and attitudes toward mathematics and computer use. The two levels of the independent variable are: computer assisted instruction in mathematics (CAI), and no computer assisted instruction in mathematics (NCAI). The two types of dependent variable are: mathematics achievement assessment, attitude assessment. Mathematics achievement is being measured by the "Key Math Diagnostic Arithmetic Test" (KM) and the "Stanford Diagnostic Mathematics Test" (SD). Two assessment instruments were selected due to the learning problems sustained by the subjects and the limited manipulation time available which resulted from the design choice of "subject as his own control." Attitudes of students, parents and teachers toward mathematics, computer use and motivation are being assessed by the "Mathematics Attitude Scale", a standardized attitude assessment tool.

Hypotheses

Three research hypotheses have been formulated:

a. Handicapped and Chapter I students experiencing CAI in mathematics will show a significant positive increase in mathematics achievement scores as opposed to mathematics achievement scores generated while experiencing NCAI.

b. Handicapped and Chapter I students experiencing CAI in mathematics will show a significant positive increase in attitudes towards mathematics as opposed to attitude changes towards mathematics when not experiencing CAI.

c. Parents of Handicapped and Chapter I students will demonstrate more accurate perceptions of their child's attitudes towards mathematics when the child is experiencing CAI than when the child is not experiencing CAI in mathematics.

Subjects

The subjects of the study are identified handicapped and Chapter I (educationally disadvantaged) students enrolled in grades one through five in two elementary schools located in Johnson County. Within Meadowlark School, there is an N of 16 handicapped and 16 Chapter I students. Clear Creek School has a smaller N of 3 handicapped and 10 Chapter I students. Therefore, the primary thrust of the research effort is directed at the Meadowlark School subjects who will receive both mathematics and attitude assessment. Clear Creek School subjects will receive only attitude assessment.

Experimental Considerations

Several problems were encountered in developing the experimental design. A relatively small number of subjects was available within the two schools selected. However, a decision was made not to include students from the other district elementary schools due to the distances of the schools from the Buffalo area, the lack of Chapter I programs in these schools, different school schedules and differences in program delivery. A second problem had to do with the relatively short time available for manipulation. Due to the school calendar, groups received treatments for a period of six weeks. An unescapable problem was that of the school versus laboratory data collection environment. Since the first responsibility of the school district is to educate the children, it was necessary to integrate the experimental design and the data collection into the school setting. However, since the research will be produced in an applied or real world setting, it is predicted that the study will have high external validity.

Experimental Design for Meadowlark Students

In January, 1983, the Key Math Test was administered to all subjects who were then matched into pairs on the basis of the test scores. Subjects from each pair were then randomly assigned to treatment order groups. One group received CAI in the area of mathematics for a period of six weeks. The second group received math instruction which was non computer assisted for the same time period. Attitudes toward mathematics and computer use were also assessed in January. Midpoint data, both mathematic achievement and attitudinal, was collected in March, 1983. Treatment orders were reversed and treatment is presently being applied for another six week period. Final data collection will take place in late April, 1983.

Data Treatment

Mathematics data analysis will apply to Meadowlark students only. Descriptive statistics on Key Math and Stanford Diagnostic are to be calculated for data collection. Inferential statistics shall be applied following the data collection termination. Analysis shall be completed by applying a 2 x 2 repeated measures ANOV.

Attitudinal data collected on the Buffalo Questionnaires and the Mathematics Attitude Scale shall be analyzed for both Meadowlark and Clear Creek students. Descriptive statistics shall be calculated for each data collection period. Analysis of Meadowlark attitudinal data will be completed by applying a 2 x 2 repeated measures ANOV. Analysis of Clear Creek attitudinal data will be completed by applying a two tailed t test for related samples. Comparisons will be made over Meadowlark and Clear Creek schools for both the Buffalo Questionnaires and the Mathematics Attitude Scale. Since these data, which will be analyzed with a two tailed t test, can be compared directly, the cause

for attitudinal change, if any, can be inferred.

Preliminary Results

As shown in Table 1, there is a high similarity between the grade equivalency scores for all 32 subjects on the Key Math and Stanford Diagnostic tests. The general conclusion based on visual inspection of this table is that the two tests are measuring the same skills. The correlation between KM and SD for 32 subjects was r = +.9604.

Table 1

Premeasure Math Tests Means and Standard Deviations for All (N=32) Subjects

Test	Raw Scores		Grade Equivalency Scores	
	$\bar{X}$	S	$\bar{X}$	S
Key Math	86.6250	30.3599	2.8556	1.0679
Stanford Diagnostic[a]	NA	NA	2.9656	1.2714

[a] Inappropriate calculations for Stanford Diagnostic raw scores.

Table 2 presents basically the same data as Table 1 with the exception that the subjects have been divided into handicapped (N=16) and Chapter I (N=16). Again the data suggest a high degree of similarity between the grade equivalency $\bar{X}$s on KM and SD for handicapped subjects. Correlation coefficient for this group was r = +.9524. Chapter I subjects also showed this similarity of grade equivalence with a correlation coefficient of r = +.9712.

Table 2

Premeasure Math Tests Means and
Standard Deviations for Handicapped (N=16)
and Chapter I (N=16) Subjects

Subjects	Raw Scores		Grade Equivalency Scores	
	$\bar{X}$	S	$\bar{X}$	S
Handicapped				
Key Math	83.1250	24.8566	2.7175	.8091
Stanford Diagnostic[a]	NA	NA	2.6625	.8809
Chapter I				
Key Math	90.1250	35.5094	2.9938	1.2890
Stanford Diagnostic[a]	NA	NA	3.2688	1.5391

[a] Inappropriate calculations for Stanford Diagnostic raw scores.

Table 3 shows only for Chapter I students, KM and SD data which has been broken down into the two treatment orders. Again, there is similarity between the grade equivalency $\bar{X}$s for the CAI-NCAI and NCAI-CAI treatment orders for both KM and SD. Visual inspection of this table suggests that comparable treatment order groups were established.

Table 3

Premeasure Math Tests Means and Standard
Deviations for Chapter I Treatment Order Groups
(CAI-NCAI=8) and (NCAI-CAI=8)

Test	Raw Scores		Grade Equivalency Scores	
	$\bar{X}$	S	$\bar{X}$	S
Key Math				
CAI-NCAI	90.2500	39.0668	3.0313	1.4665
NCAI-CAI	90.0000	34.2888	2.9563	1.1861
Stanford Diagnostic[a]				
CAI-NCAI	NA	NA	3.2750	1.7384
NCAI-CAI	NA	NA	3.2625	1.4332

Table 4 confirms what was suggested by Table 3. For the Chapter I group, no significant differences were identified between the $\bar{X}$s of the treatment groups ($p \leq .05$). Chapter 1 treatment order groups are comparable.

Table 4

Tests of Significance[a] Between Chapter #1 Order Groups Premeasure Math Tests Means and Grade Equivalency Means

Tests	Mean Differences	df	t
Key Math			
Raw Scores	.25	7	.0619
Grade Equivalency	.075	7	.4330
Stanford Diagnostic			
Raw Scores[b]	NA	NA	NA
Grade Equivalency	.0125	7	.0395

[a] t test -- tests significance of difference between means for paired observations.

[b] Inappropriate calculations for Stanford Diagnostic raw scores

* $p \leq .05$

Table 5 corresponds to Table 3 in that it shows only for handicapped students, KM and SD data which has been broken down into the two treatment orders. As with the Chapter I group, there is similarity between the grade equivalency $\bar{X}$s for the CAI-NCAI and NCAI-CAI treatment orders for both KM and SD.

Table 5

Premeasure Math Tests Means and Standard Deviations for Handicapped Treatment Order Groups (CAI-NCAI=8) and (NCAI-CAI=8)

Test	Raw Scores		Grade Equivalency Scores	
	$\bar{X}$	S	$\bar{X}$	S
Key Math				
CAI-NCAI	82.8750	25.4415	2.7225	.8444
NCAI-CAI	83.3750	26.0160	2.7125	.8306
Stanford Diagnostic[a]				
CAI-NCAI	NA	NA	2.6000	.8976
NCAI-CAI	NA	NA	2.7250	.9210

[a] Inappropriate calculations for Stanford Diagnostic raw scores.

Table 6 confirms the comparability of the handicapped treatment order groups which was suggested in Table 5. No significant differences were identified between the $\bar{X}$s of the treatment groups.

Table 6

Tests of Significance[a] Between
Handicapped Treatment Order Groups
Premeasure Math Tests Means
and Grade Equivalency Means

Tests	Mean Differences	df	t
Key Math			
Raw Scores	.5000	7	.1381
Grade Equivalency	.0100	7	.0805
Stanford Diagnostic			
Raw Scores[b]	NA	NA	NA
Grade Equivalency	.1250	7	.8036

[a] t test -- tests significance of difference between means for paired observations.
[b] Inappropriate calculations for Stanford Diagnostic raw scores.
* $p \leq .05$

Information based on the results from the Mathematics Attitude Scale is presented in Table 7 for all students (N=32) and parents of students. Visual inspection of the data suggests: similar attitudes toward math for both Clear Creek and Meadowlark students; similar parental perceptions of children's attitudes toward math for both Clear Creek and Meadowlark. A two tailed t test for unrelated samples with unequal Ns was used to determine the statistical significance of the mean differences between Clear Creek and Meadowlark students. The results ($t = -.9847$, $df = 43$, $p>.05$) confirmed the previous speculative observations that the students from the two schools were similar in attitudes toward mathematics. A similar test was applied to

determine the statistical significance of the mean differences between Clear Creek and Meadowlark parents' perceptions of their children's attitudes. The results ($t = .2669$, $df = 43$, $p>.05$) confirmed that parents from the two schools are similar in their perceptions of the children's attitudes toward mathematics.

Table 7

Premeasure Mathematics Attitude Scale Means Standard Deviations and Ns for Clear Creek and Meadowlark Students and Parent of Students

	Clear Creek			Meadowlark		
Subjects	$\bar{X}$	S	N	$\bar{X}$	S	N
Students	57.6154	11.2067	13	60.5000	7.8371	32
Parents	44.5385	9.4482	13	43.5625	11.7004	32

Table 8 presents only student attitude data toward mathematics and is divided into handicapped and Chapter I. Visual inspection implies no differences in attitude toward mathematics for the Clear Creek and Meadowlark handicapped and Chapter I students. A two tailed t test for unrelated samples with unequal Ns was used to determine the statistical significance of the mean differences between Clear Creek and Meadowlark handicapped students. The results ($t = -1.0341$, $df = 23$, $p>.05$) confirmed observations that the handicapped students from the two schools were similar in attitudes toward mathematics. The same test was applied to determine statistical significance

of the mean differences between Clear Creek and Meadowlark Chapter 1 students. The results ($t = -.4741$, $df = 23$, $p>.05$) confirmed that Chapter 1 students from both schools were similar in attitudes toward mathematics. The data presented in Table 8 and the tests of significant indicate that the Buffalo students have similar attitudes toward mathematics regardless of school attended.

Table 8

Premeasure Mathematics Attitude Scale
Means Standard Deviations and Ns
For Clear Creek and Meadowlark
Handicapped and Chapter #1 Students

	Clear Creek			Meadowlark		
Subjects	$\bar{X}$	S	N	$\bar{X}$	S	N
Handicapped	56.2500	3.0957	4	60.8125	8.5340	16
Chapter #1	58.2222	13.5442	9	60.1875	7.3414	16

Table 9 reflects attitudinal data for Meadowlark students only and has been separated into handicapped and Chapter I treatment order groups. For both the handicapped and Chapter 1 groups, the means for the CAI-NCAI treatment order and the NCAI-CAI treatment order are very similar. A two tailed t test for related samples was used to determine the statistical significance of the mean difference between handicapped students assigned to the CAI-NCAI treatment order and the NCAI-CAI order. The results ($t = -.7402$, $df = 7$, $p>.05$)

confirmed that the handicapped students in the two treatment orders have similar attitudes toward mathematics. The same test was used to determine the statistical significance of the mean differences between Chapter 1 students assigned to the CAI-NCAI treatment order and the NCAI-CAI treatment order. The results ($t = .3544$, $df = 7$, $p > .05$) confirmed that the Chapter 1 students in the two treatment orders have similar attitudes toward mathematics. Table 9 and the tests of significance indicate that the treatment order groups are comparable with respect to attitudes toward mathematics.

Table 9

Premeasure Mathematics Attitude Scale
Means Standard Deviations and Ns
for Meadowlark
Handicapped and Chapter #1
Treatment Order Groups

	Treatment Order					
	CAI-NCAI			NCAI-CAI		
Subjects	$\bar{X}$	S	N	$\bar{X}$	S	N
Handicapped	59.3750	7.6333	8	62.2500	9.6474	8
Chapter #1	60.6250	6.9269	8	59.7500	8.1897	8

FUTURE OF PROJECT, CONCLUSIONS AND RECOMMENDATIONS

It is the sincere wish of the developers of this project that district provision be made for its continuation. Several suggestions can be made for further research. The study should be replicated with larger Ns of handicapped and Chapter I students. This would facilitate the use of the traditional two group (experimental and control) approach and eliminate the need for counterbalancing. Furthermore, the manipulation could be placed in effect over a full academic year as opposed to six weeks. Other curricular areas (reading, language, etc.) should be investigated. A study such as the one described above should be replicated with non-handicapped students as subjects. A factorial design ANOV could be employed to examine the main and interaction effects of such variables as grade levels, various instructional areas, etc. Preliminary inspection of attitude data suggests that CAI may generate very different outcomes than the feared or expected dehumanization. More detailed examination of this aspect of CAI should be explored.

From a technological point of view, the expansion capabilities of the networking system should be demonstrated. During the planning period of the project, it was learned that the technology was not yet available to permit use of a phone modem with the hard disk memory system. However, this capability is in the research and development stage. When available, it would permit an extension of the system between schools.

Within the school where this system is presently operating, the number of terminals should be increased to make CAI a reality for a larger population of students (Figure 2). Portability, and the option of creating

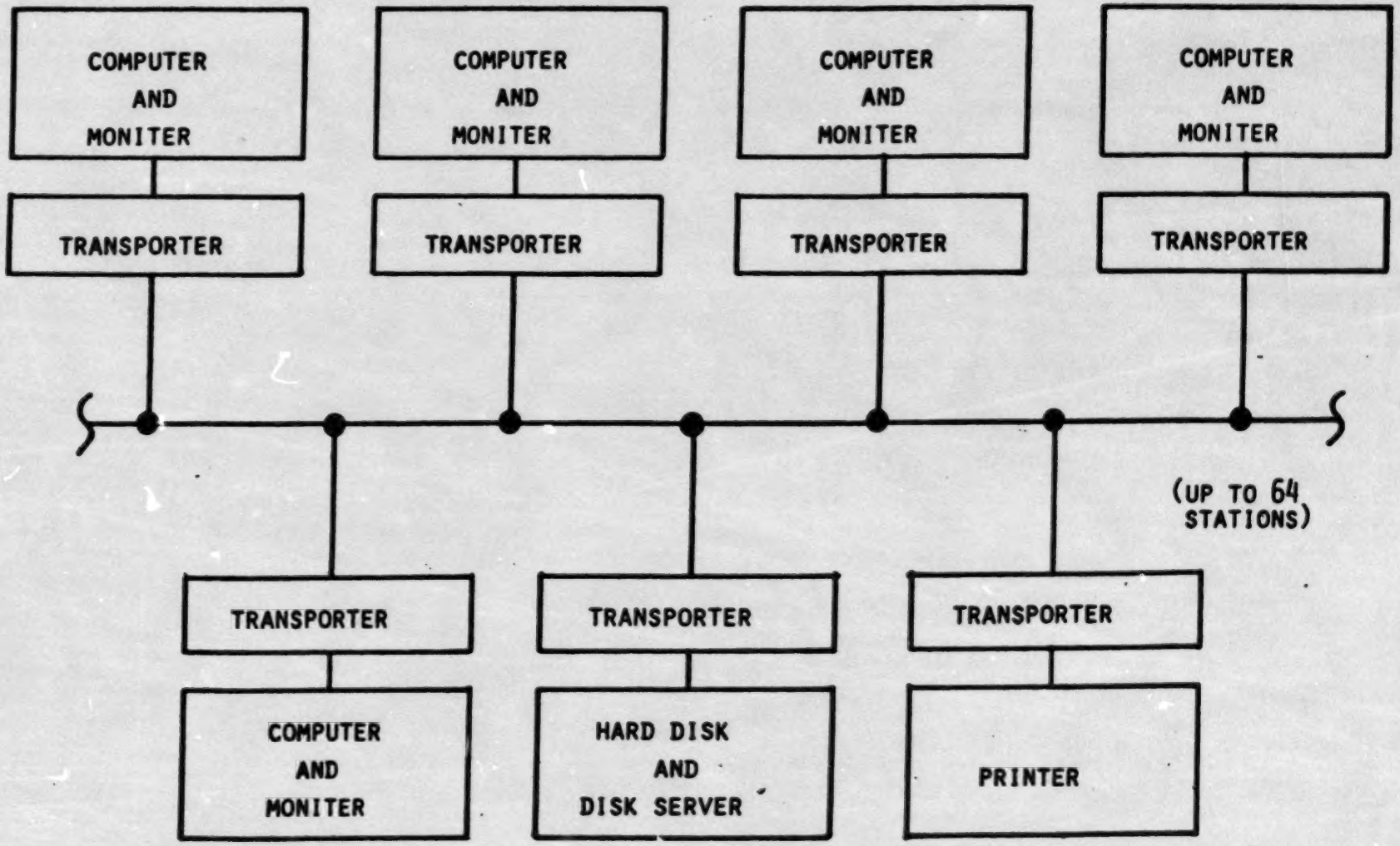
a computer laboratory as well as individual stations should be demonstrated. Since Johnson County School District offers an adult education program, the computer networking system could provide the hardware for adult classes in awareness and/or programming. Conceivably, the District could follow its present practice of making facilities available to the patrons by allowing personal use of the computers outside of school hours.

SUMMARY

In summary, it is hoped that the data generated by the study and the technology provided to students, teachers, and parents will prove educationally beneficial to all. Final results of the research study will be available by Fall, 1983. Persons interested in any aspect of the project may contact any of the presenters listed.

* * OMNINET LOCAL NETWORK * *

MEADOWLARK SCHOOL

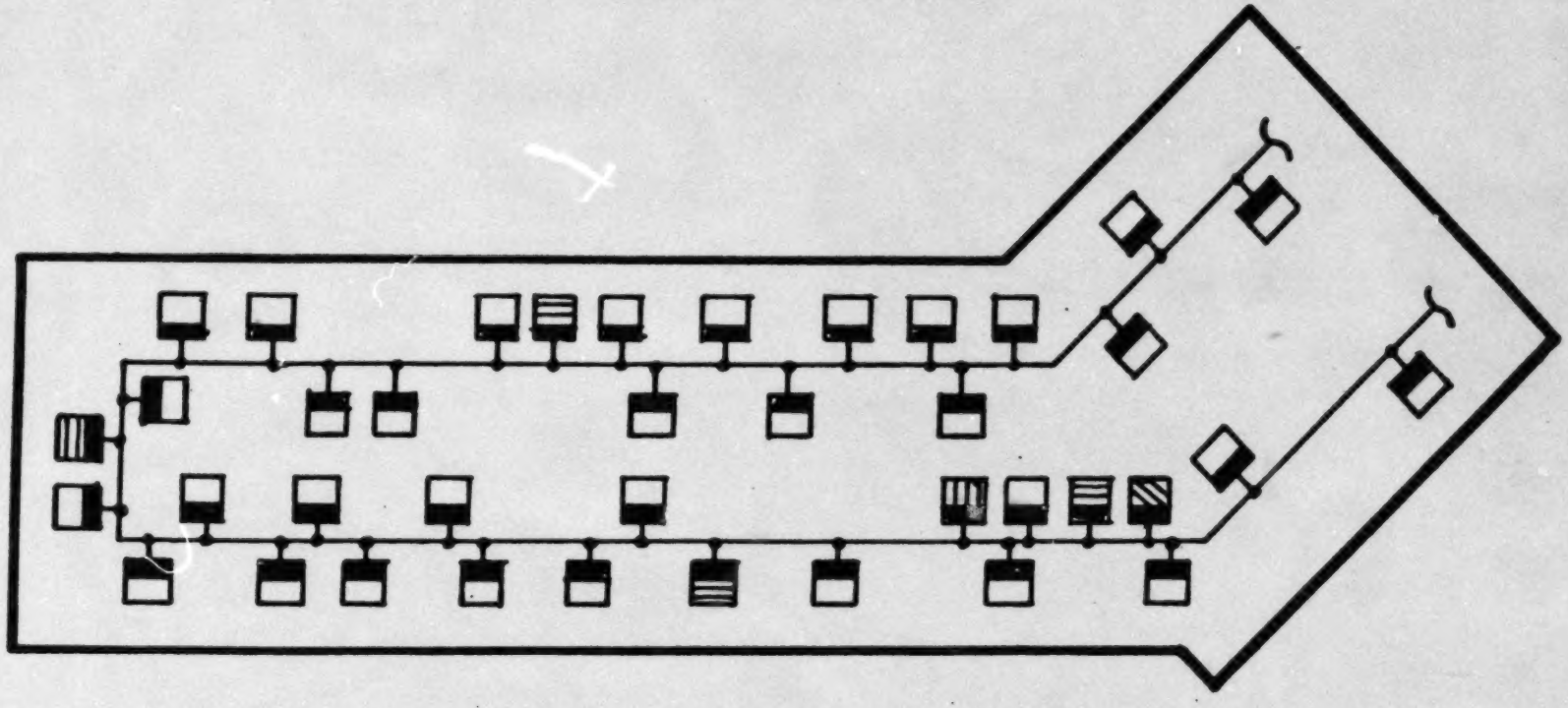


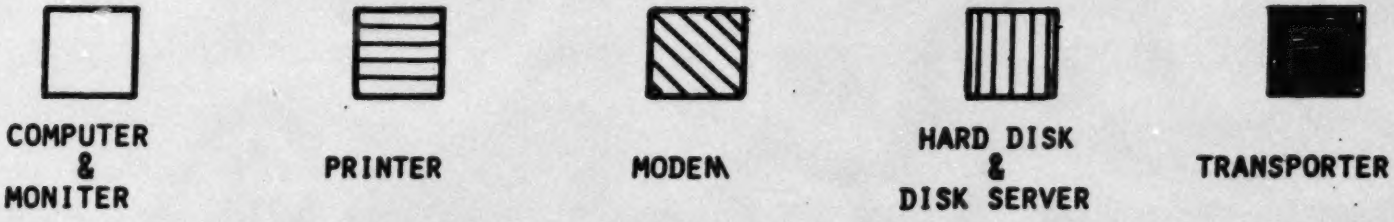
APPENDIX A - FIGURE 1

• • EXPANDED USE OF OMNINET LOCAL NETWORK • •

MEADOWLARK SCHOOL

(POSSIBLE FUTURE PLAN)





APPENDIX B - FIGURE 2

REFERENCES

Aiken, L.R. 1979. Psychological Testing and Assessment. 3rd ed. Allyn and Bacon, Inc.: Boston.

Ashcroft, S., "Young, M. Microcomputers for Visually-Impaired and Multihandicapped Persons." Journal of Special Education Technology. IV (Spring, 1981) 24-27.

Crandall, N., Mantano, M. An analysis of the impact of CAI in a program designed to ameliorate the effects of racial isolation in the Los Nietos school district. Testimony presented to the House Committee on Domestic Applications of Science and Technology, October 6, 1977.

Edwards, A.L. Experimental Design in Psychological Research. Revised Edition. Holt, Rinehart and Winston: New York.

Edwards, J. et al. "How Effective Is CAI?" Educational Leadership, 1975, 33 (147-153).

Fisher, Glenn. "Disk Sharing: How to Make One Disk Go 'Round." Electronic Learning, I No. 5 (May/June, 1982), 46-51.

Friedman, H. 1972. Introduction to Statistics. New York: Random House.

Geller, Irving. "Business Outlook-Apples For Teachers Pay Off." High Technology, III No. 3 (April, 1983), 45.

Grimes, L. "Computers Are for Kids: Designing Software Programs To Avoid Problems of Learning." Teaching Exceptional Children. November, 1981.

Joiner, L.M., et al. "Microcomputers: An Available Technology for Special Education." Journal of Special Education Technology, III (Winter 1980), 37-41.

Lewis, R., Rossett, A. "Educational Technology As Perceived by Special Educators." Journal of Special Education Technology, III (Winter 1980), 43-49.

Siegel, S. 1956. Nonparametric Statistics for the Behavioral Sciences. McGraw-Hill Book Company: New York.

Suppes, P., Morningstar, M. Computer Assisted Instruction At Stanford, 1966-68. New York: Academic Press, 1972.

Taylor, A. "An Evaluation Of A New Approach In Dealing With High School Underachievement." Fairfield, Conn. Fairfield University, 1969.

University of Wyoming, Math and Science Teaching Center. Report of the committee, Instructional Computing in Wyoming: Status and Recommendations. 1981.